COMPLETED PROJECT

Forest Products

Project Fact Sheet

4-D CHARACTERIZATION OF PAPER WEB AT THE WET END

BENEFITS

- Improved productivity
- Enhanced product quality
- Reduced waste

APPLICATIONS

This technology is intended to be transferred to the paper industry, where it can be integrated into paper machines. It will monitor the wet end of the paper machine, where it will measure the uniformity of the slurry and predict paper web parameters. By doing so, it will allow all paper manufacturers to more closely control the paper-making processes to ensure a higher quality end product.

Technology to Characterize the Web Between the Headbox and the Dryline

The paper industry is developing technologies that will allow measurements of 100 percent of the web. This capability will help the industry become more productive, improve its product quality, and reduce processing wastes. Investigators are focusing on the region between the headbox and the dryline, the so-called "wet end" of the paper web, and on developing "intelligent" sensors to capture and analyze images and thereby automatically measure the web's parameters.

This project will enable the industry to automatically measure the wet end and predict such web parameters as the sheet formation index and impending web breaks. This will ensure that paper processing can be adjusted early to increase the production yield and product quality. Although using the wet end for these measurements is "uncharted territory," two national laboratories and several industry partners have combined to ensure the success of the project.

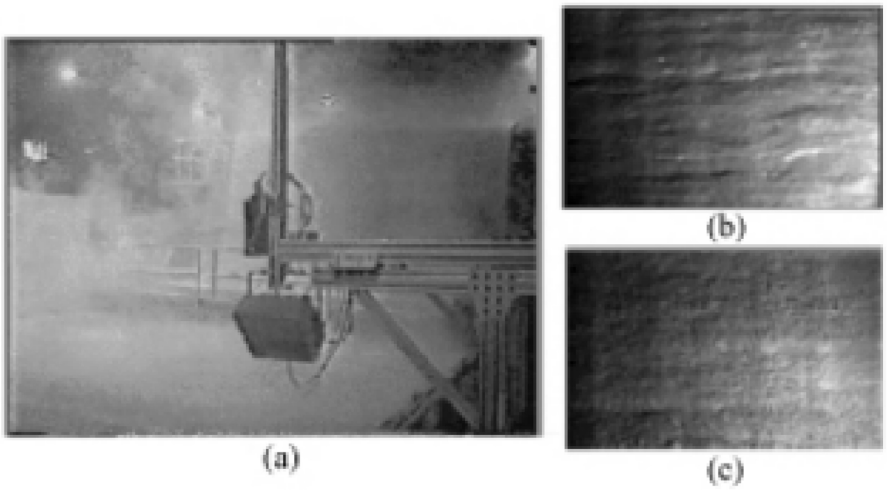

Figure 1. (a) Deployed stroboscopic system in Union Camp's Savannah Mill. (b), (c) High resolution images of the slurry depicting web structures.

Project Findings

The paper industry has long needed better understanding and control of its papermaking process at the wet end, most particularly in the forming section. Most in the industry believe that crucial paper properties such as formation are irreversibly set by the time the slurry (wood fiber and water mixture) leaves the wet end and enters the pressing section. Therefore, effective process control to record and analyze the pertinent paper characteristics upstream as close to the headbox as possible is seen as vitally important to the industry.

The objective of this project was to design, develop, and implement a visual system for characterizing the paper web at the wet end. The system was intended to use a CCD area sensor and a strobe light that captures static images of the web integrated into a system of image-processing algorithms that can recognize the 3-D characteristics of the web structure. Using this system, it would be necessary to capture 4-D measurements of the slurry, including x and y coordinates (machine-direction and cross-direction, respectively); the intensity profile, ¦(x,y); and the depth profile, z(x,y). These real-time measurements would be used to design image-processing algorithms to quantify the 4-D characteristics of the web structures.

The vision system developed during this project successfully detects and localizes nonuniformities that appear on the paper slurry at the wet end of a paper machine. Specifically, the system monitors the paper slurry as it exits the headbox and alerts operators of any streaks or other nonuniformities that disrupt the otherwise homogeneous background, which are thought to affect crucial product properties such as formation that impact the strength, printability, and thickness of the final product. In essence, the system uses intensity and topographic information as well as texture-based features to detect problem areas, and facet-based descriptors to localize the areas. Following development and testing in the laboratory, researchers constructed and deployed a prototype of the system to a paper mill, where they evaluated its performance under realistic conditions. The system was installed on a fourdrinier paper machine and run at 480 meters per minute to produce linerboard material. The system was able to successfully detect and localize slurry streaks in an approximately 1 meter-wide area.

Awards, Patents, and Invention Records

An invention disclosure was submitted in February of 1998.

Project Partners

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